

REMARKS

This application and the prior art have been further reviewed, in light of the Advisory Action dated March 11, 2009. Claims 1-8, 12 and 13 are presented for examination, of which Claims 1, 12 and 13 are in independent form. Favorable reconsideration is respectfully requested.

The nature of the present invention and the cited references has been adequately discussed in previous amendments, and it is not believed necessary to repeat that discussion in full. Accordingly, Applicants will direct the following discussion to specific portions of the independent claims that are not believed to be taught or suggested by the prior art.

Claim 1

Claim 1 recites, among other features, “a resistivity of the zinc oxide layer on the surface in contact with a unit photovoltaic element near a substrate as seen from the zinc oxide layer is higher than a resistivity of the zinc oxide layer on the surface in contact with a unit photovoltaic element farther from the substrate as seen from the zinc oxide layer.”

As discussed previously, *Nakajima* relates to an apparatus comprising an intermediate transmission/reflection (ITR) ZnO layer serving as a transparent conductor between 1) an amorphous silicon thin-film cell in a p-i-n structure (a-Si layer) of one unit photovoltaic element (UPE) and 2) a reflective metal layer. The ITR layer serves as a transparent conductor by possessing good multifunctional control of electrical and optical properties – realizing a good electricity junction with respect to 1) and good light transmittance with respect to 2) (*see* Abstract).¹

¹ Also *see* http://en.wikipedia.org/wiki/Solar_cell, the “Transparent conductors” section and <http://www.chemistry.ohio-state.edu/woodwardgroup/transparentconductors.html>. It is to be noted that these sites are not cited as evidence of any sort, but are merely referred to as providing a clear discussion of this point

Apparently, in *Nakajima*, light reflected by the reflective metal layer comes from the side where 2) is, and 1) is closer than 2) to the substrate (*see* Fig. 1 and para. [0033]). Accordingly, it is desirable to let light come through on the light-incident side of the ITR layer, on the one hand, and let electricity come through on the substrate side of the ITR layer, on the other hand (*see* para. [0034]). The *Nakajima* apparatus achieves this objective by having a lower impurity concentration on the light-incident side of the ITR layer for more light to come through and a higher impurity concentration and *thus lower resistance on the substrate side of the ITR layer* for more electricity to come through.

Therefore, *Nakajima* does not disclose or teach that “a resistivity of the zinc oxide layer... near a substrate... is higher than a resistivity of the zinc oxide layer... farther from the substrate.” In fact, it teaches away from the features of Claim 1, which also helps explain why it would not have been obvious to one of ordinary skill in the art at the time of the present invention to modify the *Sano* or rather *Ishihara* system based on the teaching of *Nakajima*.

First, none of *Sano*, *Ishihara*, and *Nakajima* discusses electrical defects leading to decreased shunt resistance, passivation as a treatment of such defects, and any difficulty that might arise from a configuration of stacked UPEs. Since *Nakajima* also teaches away from the features of Claim 1, Applicants do not see at all how it would have been obvious for one to take a stack of one UPE where light is incident, one ITR layer, another UPE, and a substrate, in that order, according to *Sano* or rather *Ishihara*, and apply the teaching of *Nakajima* in such a way as to implement the features of Claim 1.

Accordingly, for at least the reasons noted above, Claim 1 is believed to be allowable over *Sano*, *Ishihara*, and *Nakajima*, considered separately or in any combination.

Claims 12 and 13

Claim 12 recites, among other features, that “the second layer [light-incident side of the ITR layer, composed of ZnO in one embodiment] is formed at a rate higher than that of the first layer [substrate side of the ITR layer, composed of In_2O_3 in the embodiment].” Similarly, Claim 13 recites, among other features, that “the second layer is formed at a temperature lower than that of the first layer.”

As discussed previously, *Mahan* relates to a method for fabricating an a-Si:H layer to be used as semiconductor material. Specifically, this layer would be part of a UPE rather than of an ITR layer, and an UPE and an ITR layer are completely different entities. Therefore, *Mahan* does not disclose or teach “the second [sub-]layer [of an ITR layer] is formed at a rate higher than that of the first [sub-]layer ” or “the second [sub-]layer is formed at a temperature lower than that of the first [sub-]layer.”

The Office Action states that “it would have been obvious to one of ordinary skill in the art at the time of the present invention to incorporate higher deposition[-rate] techniques at lower temperatures as taught by *Mahan* to the photovoltaic tandem cell of *Isihara* in order to control [or actually increase] the hydrogen content thereby controlling the properties of the silicon layer of the cell [namely, the a-Si:H layer of a UPE element].” Even assuming that were the case, it has nothing to do with the present application as *Mahan* has nothing to do with the manufacturing of an ITR layer normally composed of ZnO and/or In_2O_3 . *Mahan* certainly does not discuss why one side – substrate side – of an ITR layer or any layer should be formed at a lower deposition rate and higher temperature while the other side – light-incident side – of the ITR layer should be formed at a higher deposition rate and a lower temperature.

Accordingly, for at least the reasons noted above, Claims 12 and 13 are believed to be allowable over *Ishihara* and *Mahan*, considered separately or in any combination.

A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

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